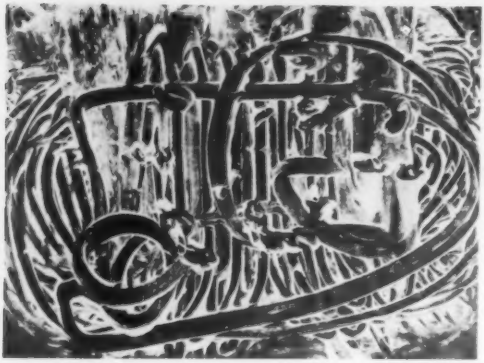
THE SCIENCES

PUBLISHED BY
THE NEW YORK
ACADEMY OF
SCIENCES

The Sciences
VOL. 1, NO. 12, NOVEMBER 15, 1961



CONTROLLING TICK-BORNE ENCEPHALITIS

TICK-BORNE ENCEPHALITIS encompasses a variety of virus infections that usually affect the central nervous systems of man and beast, and have, for some time, been of more than passing concern in many parts of the world.

Efforts to control the spread of the disease in Eastern Europe are described in a paper presented to The Academy's Division of Microbiology by Dionys Blaskovic, of the Institute of Virology of the Czechoslovak Academy of Sciences.

"Man," he notes, "does not actually play a role in the circulation of tick-borne encephalitis virus in nature; he is the dead link in the chain of infection." Virus circulation in Nature, he says, is effectuated by different instars of ticks of the Ixodidae family, which act both as vectors and reservoirs of the virus.

All of the viruses do not have the same effect. For example, Central European encephalitis and biphasic meningoencephalitis generally occur in mild forms, whereas Russian spring-summer encephalitis may result in paralyses, destruction of nerve centers and death.

Transmission of the first two viruses by the Ixodes ricinus tick is described in the paper. Larval instars feed chiefly on small vertebrates and only occasionally on the larger beasts and man. The nymphal instar feeds on all, but especially on the grazing domestic

animals. Adult ticks are found almost exclusively on all large wild and grazing domestic animals, and man.

The feeding of infectious ticks on animals that have acquired immunity following a previous infection will not cause viremia, whereas nonimmune animals will develop viremia of varying duration.

In fact, according to the writer, the "state of immunity of host animals . . . can be one of the regulators of the amount of virus present in ticks and of the total amount of virus present in a natural focus of infection." Virus doses from ticks act as revaccination doses in immune animals, whereas antibodies in immune animals affect, to some extent, the virus present in ticks.

Man can become infected by a tick bite or by drinking raw milk. He may possibly become infected as result of inhaling infective tick feces when processing wool and furs from domestic animals.

Commenting on the means that can be taken to control tick-borne encephalitis, the writer cites as most important those measures that will lead to the substantial lowering or elimination of the tick population in nature. He attributes the disappearance of the disease in some West European countries to such steps as agrotechnical care of meadows and fields, improvement of footpaths, removal of shrubs from pastures and bans on pasturing cattle in woods.

In the U.S.S.R., he adds, dusting of the ground with insecticides from the air is an important control measure. The most satisfactory substance was found to be 10 per cent DDT. Pointing out that acaricides applied to pastures may endanger the health of cattle or the quality of milk, the writer suggests their use in forests before workers enter them, or on individual animals.

To protect humans, the Russians use a formalized vaccine consisting of a 5 per cent emulsion from infectious mouse brains inactivated by formol (1:2000) in a fluid or lyophilized state. While this does not protect everyone from infection, vaccinated persons do not contract the severe or fatal form of the disease. Vaccination is carried out in new settlers and in persons working in forests known to be a natural focus of infection.

Since mouse-brain vaccine is "not an ideal substrate for parenteral administration to man because of its allergizing properties, and

because of the possibility that it can induce demyelizing processes," the writer believes emphasis should be placed on "the possibility of introducing a vaccine from virus propagated in tissue cultures." He notes that a search for a living apathogenic virus strain is to be made.

In Czechoslovakia efforts have been launched to protect man against infection from milk by vaccinating cattle. The writer notes that preliminary reports on the vaccination of domestic animals grazing in a natural focus of infection indicate promising effects can be obtained, especially when live-virus vaccine is used. Although he holds such measures can be successful only if the animals graze in a natural focus of infection, he adds that "even in such regions a single form of intervention will be insufficiently effective in disturbing the virus circulation if not combined with other means."

The problem, he concludes, is not an easy one because the "methods of research and control of an infection of this kind are complicated. The solution of these problems requires the teamwork of different specialists and the collaboration of different working groups throughout the world." □□

STRONTIUM IN THE TEETH

MEASUREMENT OF THE ABSORPTION of strontium-90 in humans has been aided by the establishing of a world-wide network of sampling stations, accumulation of data on stratospheric inventory and rate of fallout versus cumulative deposits in the soil, and studies of plant and animal life.

There have, however, been a number of restraining factors: Among others, it has been difficult to obtain sufficient numbers of

whole skeletons for analysis; adult bones show varying rates of strontium-90 absorption due to disparate exchange rates in different bones; strontium-90 has been present in human diet for a relatively short time.

Results of a recent survey in St. Louis indicate that analysis of teeth may offer a practical method of monitoring strontium-90 uptake among large populations. Reporting on this project in *Science*, Dr. Louise Zibold Reiss, Vice President and Director of the Baby Tooth Survey, Greater St. Louis Citizens' Committee for Nuclear Information, says early analysis of deciduous teeth can provide a "continuous record of strontium-90 absorption in man which will span the entire fallout period anywhere in the world."

Metabolisms of strontium-90 and calcium are similar. Absorption of strontium-90 in the bones and teeth is greatest during the period of growth. Deciduous teeth, which have a chemical composition similar to bone, are plentiful and available.

Furthermore, since tooth enamel after calcification is a nonviable and fairly stable structure that can be expected to retain the mineral composition acquired at the time of formation, the deciduous tooth would provide information on the amount of strontium-90 uptake during the year of the donor's birth – anywhere from 5 to 12 years prior to the time of shedding.

In the survey, a total of 61,000 teeth was collected in 2.5 years, proving the possibility of large-scale community cooperation.

Questionnaires distributed to donors elicited information on factors that might affect strontium uptake by teeth, such as: child's birth date; date tooth was lost; mother's residency during pregnancy; residence of child during first year of life; duration of breast and formula feeding; type of milk used in formula.

Selected for the study were incisor teeth from children who had lived in the St. Louis area during the first year of life and whose mothers had spent the prenatal period in the area. Severely decayed teeth and those of children fed milk substitutes were excluded. Breast-fed samples were the teeth of children who had suckled one month or more; bottle fed samples were the teeth of children who had received no breast milk.

Previous research suggested that breast milk contained only

one-tenth the ratio of strontium-90 to calcium found in mothers' diets. The survey, however, revealed a comparable concentration of strontium-90 in teeth of both bottle-fed and breast-fed babies, except in those samples where 35 per cent of the tooth donors had breast-fed six months or longer. This indicated, according to Dr. Reiss, that a "minimum period of breast feeding of four months for donors of samples designated 'breast fed' may magnify differences that are barely suggested in the initial study."

During the survey, examination of stillborn infants revealed that teeth and bones developing in the same biologic environment *in utero* accumulate strontium and calcium in the same ratio. This was regarded as indicating that deciduous teeth give an accurate picture of strontium concentration in bone.

In order to calculate fetal-bone and fetal-tooth concentrations of strontium-90 from concentrations found in shed teeth, it was necessary to know the extent of prenatal and postnatal tooth formation and the degree of placental discrimination against strontium-90.

The portion of a tooth formed prenatally accumulates less strontium-90 than that formed postnatally. J. Laurence Kulp, Arthur R. Schulert, and Elizabeth J. Hodges, of Columbia University, have observed that because of placental discrimination the concentration of strontium-90 in fetal skeletons is one-twelfth that in mothers' diets.

To determine how much of the tooth was formed prenatally, the average weights of four tooth types from stillborn infants were compared with average weights of noncarious shed teeth. It was found that 32 per cent of the average incisor, 17 per cent of the first molar, 6 per cent of the cuspid and 5 per cent of the second molar were formed prenatally.

According to Kulp and his associates, previous tests have shown that one-fourth of the strontium goes from diet to bone. Given the prenatal diet-to-tooth ratio of 1 to 12, and the postnatal ratio of 1 to 4, "the concentration of strontium-90 added to the tooth postnatally would be three times that added prenatally if dietary strontium-90 remains constant," says Dr. Reiss.

With the increase in fallout it is possible to utilize much smaller pools of teeth for future analysis, says Dr. Reiss. She recommends incisors as the best subject for studies, because they can be collected

easily, the incidence of caries is low, and a shorter period elapses between formation and shedding than in the case of cuspids and molars.

Based on the St. Louis experience, Dr. Reiss concludes that "5,000 incisor teeth a year collected on a continuing basis from any area, should, after two years, yield adequate data on absorption of strontium-90 approximately seven years before the start of the collection." □ □

EPIDEMICS AND STARLINGS

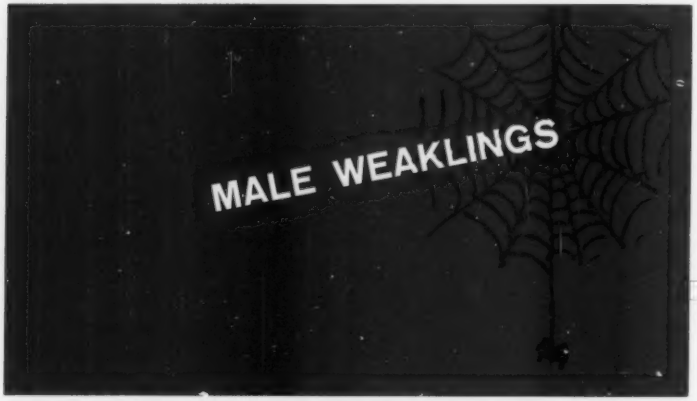
WHEN FOUR BOY SCOUTS of Troup 36 in Mexico, Missouri, recently developed high fevers, chills and coughs, serologic tests showed infection with *Histoplasma capsulatum*. There was no question of the epidemic proportions of the infection when it was found that 97 per cent of 64 scouts "had positive histoplasmin skin tests, 60 per cent had positive complement-fixation tests for histoplasmosis, and 47 per cent had active lesions," as reported by Public Health Service epidemiologists.

Two weeks earlier, scouts from the town's four troops had volunteered to assist the town to clean out an overgrown area which was to become a public park: Soil samples collected from the area showed 62 per cent positive for *H. capsulatum*. Reviewing the history of such infections, the investigators (reporting in the *New England Journal of Medicine*) found that epidemics had been reported in Rockford, Illinois, in 1955; Mountain Home, Arkansas, 1956; Dallas County, Alabama, 1958; and Sturgis, Mississippi, 1959.

Until recently, three sources of histoplasmosis infection had

been reported: visits to farms or prior rural residence; exposure in urban dwellings contaminated by bird droppings; and importation of contaminated farm soil or manure as fertilizers. The Missouri incident points up a fourth source: bird-contaminated, open-park lands within cities.

Epidemic histoplasmosis has been linked with the razing of buildings that had been favorite roosts for pigeons and starlings. The Public Health team's evaluation of the evidence is that "city dwellers contract histoplasmosis by contact with point sources of growth of the organism and not by the casual inhalation of windborne spores disseminated throughout the city." The congregation of huge flocks of birds in urban areas, and their possible contamination of park areas and playgrounds, presents a new and difficult problem for health departments. □ □



THE SPIDER WHOSE PERSEVERANCE inspired Robert Bruce to try again was in all probability a female. Recent observations tend to support the theory that a male would not have had the strength to make a seventh attempt to put up a web.

Theodore Savory, of Stafford House College in England, a student of the mores of spiders, believes "male spiders are never very robust." Writing in *Natural History,* he asserts: "Far from being full of the virility that the stories of their dances suggest, far from showing an enhanced activity from 'the greater metabolism of the male' mentioned in textbooks, the males are weaklings. . . . "

Savory's observations dispute three myths concerning spiders:

male spiders are rare; they do not spin webs; they are eaten by their mates.

During more than three-quarters of their lives males cannot be distinguished from females, and there is no difference between male and female activities. Actually, half of the supposed females are "unannounced males."

In nearly all male animals the testes are directly connected by two ducts, *vasa deferentia,* to an organ that either ejects sperm over eggs or transfers it to the body of the female. In the male spider the testes are in the abdomen and the *vasa deferentia* open just behind the waist. However, the intromittent organs are not nearby but are found at the ends of the pedipalpi, two limbs that extend from the sides of the spider's mouth and in front of its first pair of legs.

In young and female spiders the pedipalpi are tactile organs. A change occurs in the mature male spider by the time the next-to-the-last molting period begins. The tips of the palps swell and alter in appearance. First they look like fingers, then like thumbs with a single terminal claw. By the time of the final casting off of skin, the palps become hollowed, spoonlike containers.

Among sub-adult males of the genus *Tegenaria,* Savory was unable to detect any change from "female" behavior. Before molting, the males "spin normal webs . . . feed with the usual greed . . . and in no way support the dictum that coming events cast their shadow."

The male *Tegenaria* that has just molted for the last time will spin a web and feed on flies for perhaps a fortnight before a change occurs. At this point his palpal organs are ready to receive the sperm, but the palps are too short to make contact with the sperm-emitting orifice in the abdomen.

The spider overcomes the problem by spinning a small sperm web, triangular or rectangular in shape, and hung at an inclined or vertical angle. Then he deposits a drop of semen on it by rubbing his abdomen on the web, applies his palps to the fluid, and draws it up by surface tension. Now the male *Tegenaria* is fully charged to begin his search for the female.

According to Savory, a male spider may walk as much as 90 yards before reaching his goal, although he is likely to be worn out by the time he goes 50 yards. But since the number of spiders of all

species per acre may total more than two million, says Savory, "it seems unlikely that any male spider runs much risk of bachelorhood."

When the male *Tegenaria* reaches the web of his future mate his pedipalpi drum on it, setting up a distinctive vibration. The disturbance caused by a fly would bring the female spider rushing out for the kill, but in this case the female awaits the male who approaches slowly, drumming unceasingly all the while.

The search, the courtship and the mating, says Savory, are strenuous activities. "Sometimes the search has been so tiring that the courtship is imperfectly performed; sometimes the courtship is so strenuous that the male cannot finish it; finally, there is at least one case on record in which the wearied male died during mating."

His conclusion is that the death of the male spider is "due to its constitutional weakness and not, as is usually thought, to its mate's cannibalism."

Even if it survives, "fulfilment of its function in continuing the species leaves the male spider without purpose," contends Savory. Male spiders who forsake their webs to go wooing have "sacrified their chances of ever catching another fly, and condemned themselves to starvation." □ □

MAMMOTHS AND [illegible] DEEP-FREEZE THEORY

DESPITE NUMEROUS EXERCISES in data interpretation, the available explanations fail to dispel much of the mystery surrounding the Pleistocene woolly mammoths found frozen in northern Siberia. Lack of detailed knowledge of the distribution, geologic context and age of the mammoths contributes to the durability of the puzzle.

Popular accounts tell of the discoveries of numerous undamaged and fresh carcasses, supposedly preserved through some sudden, catastrophic, quick-freezing process. Actually, there has been a total of only 39 discoveries of frozen, but rotten, woolly mammoth remains, of which four were found in a nearly complete stage. The four are: Adam's mammoth, recovered from the Lena delta in 1806; Herz's mammoth, Berezovka River in 1899; Stenbock-Fermor's mammoth, Great Lyakhov Island, 1906; and Vollosovich's mammoth, Sanga-Yurakh River, 1907.

William R. Farrand, research associate in Pleistocene geology at Lamont Geological Observatory, is convinced that the woolly or northern mammoths were able to "survive a glacial onslaught." A member of the geology department of Columbia University, Farrand has written in *Science* that "climate apparently did not play a direct role in the demise of the Siberian mammoths. Woolly mammoths were well adapted to extreme cold and to tundra vegetation. . . . "

The body of the woolly mammoth was covered with long coarse hair and thick underfur. The fat under its epidermis was up to 9 centimeters thick. Unlike today's pentadactylic elephant, the *Mammuthus (Elephas) primigenius* had broad, four-toed feet suitable for maneuvering in marshy terrain.

The fact that, aside from the woolly rhinoceros, not one of the mammoths' Pleistocene neighbors (stag, horse, reindeer, musk ox) has been found in a frozen and preserved state, indicates to Farrand that "some peculiarity of their physique" was a contributing factor to the fate of the woolly mammoths.

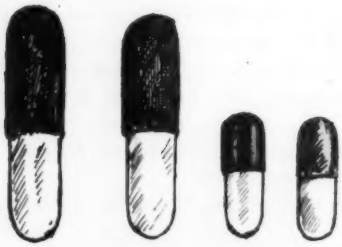
Because of his stiff-legged gait the mammoth would have had difficulty in crossing even small gullies and it would have been nearly impossible for him to extricate himself once he had fallen in. The low-slung rhinoceros would have had similar trouble. The mammoth's weight would also have been "a dangerous attribute" if the animal grazed too close to the edge of a bluff softened by the sun.

Many grasses, sedges and other boreal meadow and tundra plants were found in the stomachs and between the teeth of the preserved mammoths. To Farrand this indicated that "death occurred in the warm season . . . when melting and solifluction would have been at a maximum and, accordingly, locomotion would have been difficult."

It also indicated that the climate was milder and moister than it is today.

In rebutting the theory of sudden, deep-freeze catastrophe, Farrand also cites the fact that histological examination of one of the mammoths revealed chemical alteration as result of "very slow decay," and that "even the frozen ground had the same putrid odor, implying decay before freezing."

The woolly mammoths must have died "suddenly, probably from asphyxia, resulting from drowning in a lake or bog or from being buried alive by a mudflow or cave-in of a river bank," concludes Farrand. "The frozen giants are indicative of a normal and expected circumstance of life on the tundra." □ □



ON DRUGS AND REPRODUCTION

PHARMACOLOGICAL REGULATION of reproductive functions in man may be one of the results of efforts to use drugs to control endocrine functions.

Discussing endocrine pharmacology in *Science*, Robert Gaunt, director of biologic research; J. J. Chart, associate director of endocrinology; and A. A. Renzi, associate director of physiology of Ciba Pharmaceutical's Research Department, note that new work utilizing drugs in the study of neurological phenomena promises "systematic and profitable exploitation."

Practically speaking, say the authors, "it would be more useful to have glandular inhibitors rather than stimulants because an excess of hormone usually can be obtained, when needed, by direct administration of the hormone in any quantity." Some of the more

obvious means of achieving inhibition by drugs are listed as:

"Damaging," reversibly or otherwise, the glandular secretory cells that produce hormones; inhibiting some specific step in the biosynthesis of a hormone; blocking the stimulus causing glandular secretory activity; blocking the uptake of an essential raw material for hormone synthesis; cutting off production of an essential precursor to hormone synthesis; or preventing the reaction of a hormone at a receptor site.

While conceding that drugs to achieve most of these effects are available, the authors suggest their lack of widespread use indicates the need for better drugs.

Earlier studies produced vital data about the influence of drugs on the secretion of gonadotropins. For example, the secretion of luteinizing hormone in the rabbit, which causes ovulation under the stimulus of copulation, can be blocked by some antiadrenergics and by anticholinergics. In the rat, which has a different type of reproductive cycle, the administration of such drugs as atropine, dibenamine, barbiturates, morphine, SKF-501, chlorpromazine and reserpine blocked spontaneously occurring ovulation when given at certain stages of the estrus cycle. In the hen, atropine and SKF-501 are effective in blocking ovulation; barbiturates are not. Enheptin, used in treating infectious diseases in birds, causes sterility in chickens, but not in mammals.

Some of the newer tranquilizing drugs can affect anterior pituitary function so as to inhibit estrus, menstruation and fertility, say the authors. But this effect, they add, is not carried over to the lactogenic hormone of the pituitary, which, in some species, including man, is stimulated to induce lactation under certain conditions.

The authors note that all the drugs mentioned, and which are "believed to affect reproductive functions in mammals through modification of gonadotropin secretion, are drugs which act on the autonomic or central nervous systems." Generally, they mediate some aspect of the metabolism of the neurohumoral catechol amines, but sites and details of their action vary widely.

Drugs which act "more specifically," say the authors, "would be of great potential use, both in clinical medicine and in animal husbandry, in treating reproductive dysfunction and in controlling – particularly in inhibiting – fertility." □ □

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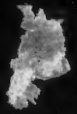

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